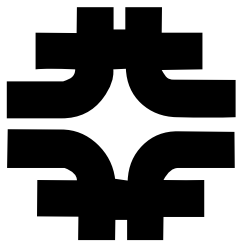
On the Correlation between effective lattice function $D_{11/17}$ & BPM position



Paul Lebrun

Fermilab

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Study Goals

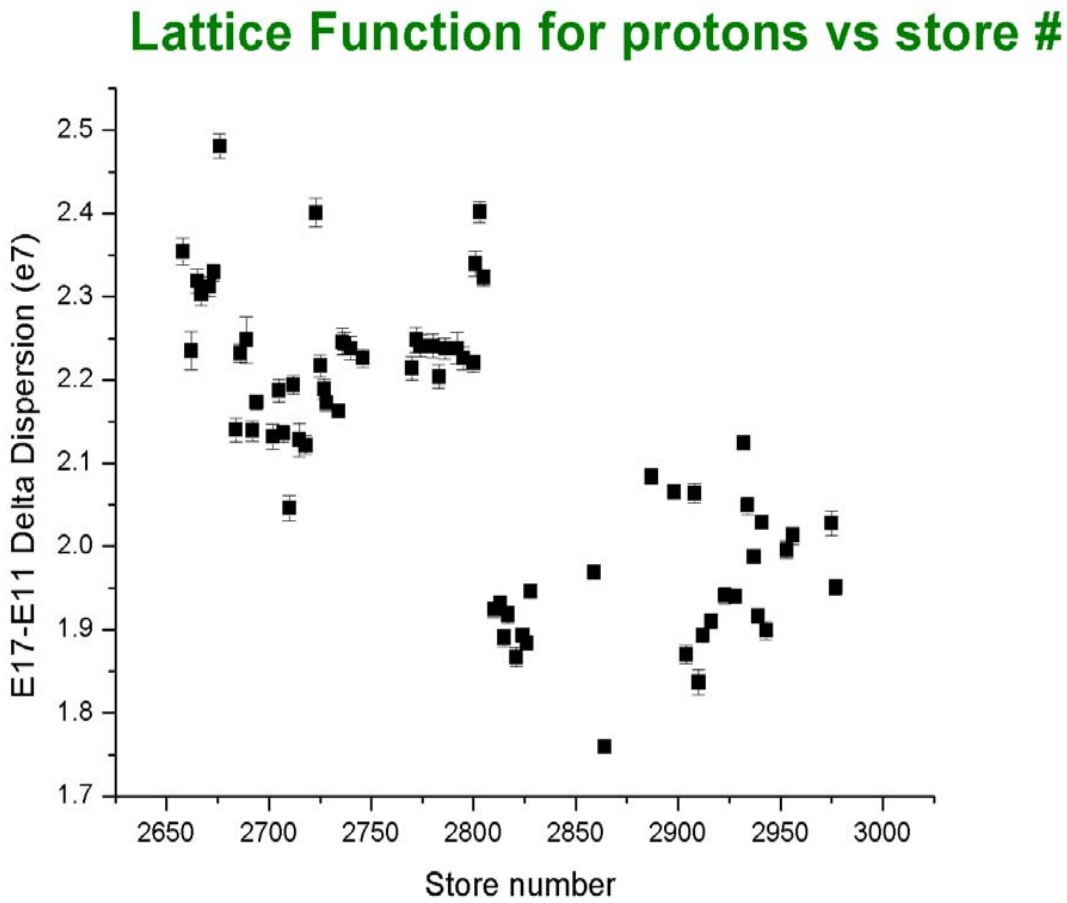
- Two weeks ago, Krzysztof G. showed us convincing evident that the lattice function $D_{11/17}$ varies store to stores. We do not intentionally change the lattice. However, if the helical orbit varies store to store, then, the effective dispersion and β function may vary, because of higher field multi-poles through which the proton beam goes. It was therefore suggested that we attempt to correlate BPM position with $D_{11/17}$, defined as :

$$D_{11/17} = D^2_{17} - (\beta_{17}/\beta_{11})\, D^2_{11}$$

Study Goals, Caveat

- Alvin T. showed last week that this function is quite sensitive to the momentum distribution. The flying wire at E17 measures mostly the spread of this distribution, because the D_{17} is so large. However, Alvin also claims that these momentum distributions are quite stable, store to store. So, although there is probably a large uncertainty in the absolute value of $D_{11/17}$ (due to the unfolding of the non-Gaussian features of this momentum distribution), the cause for this store to store variation remains to be understood.

$D_{11/17}$ vs store number, from Proton Data



Only Proton data, for sake of brevity

Note the statistical errors, estimated from 36 measurements, are much smaller than the store to store variation.

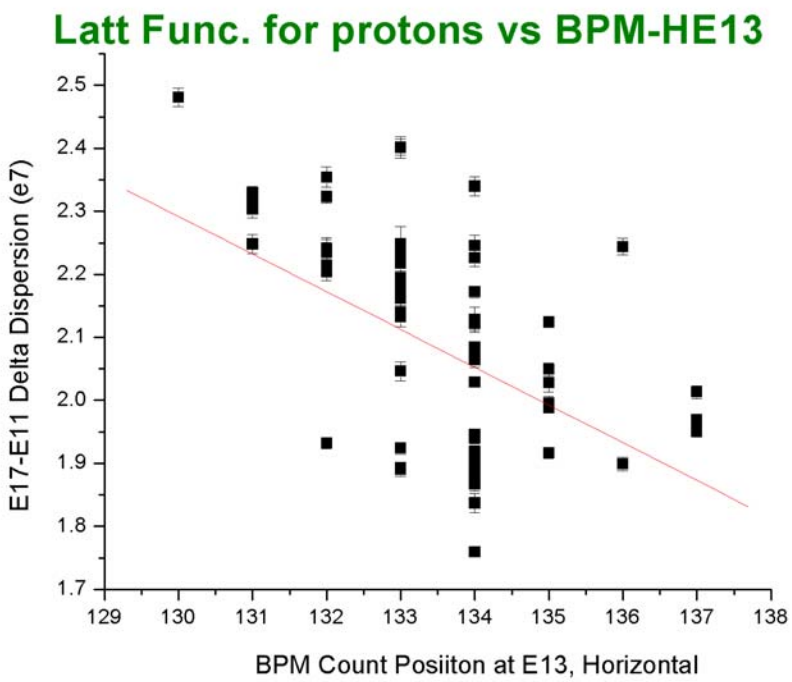
BPM data

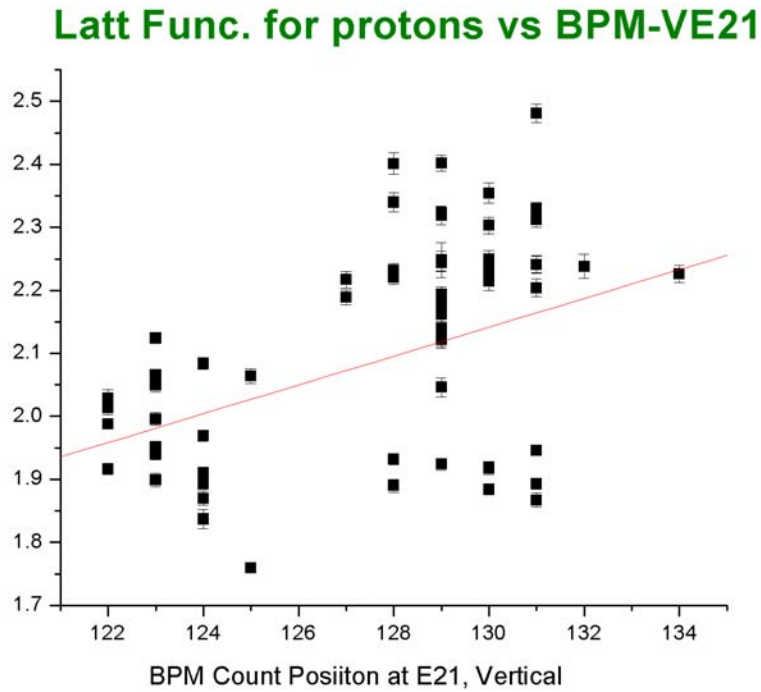
– We have two kinds of BPM: the old ones, and 3 “new” ones, equipped with the Echo-Tech boards, which presumably are more stable and reliable than the “old” electronics. However, these are installed at the location A11, B49 and F49, far away from the E11/E17 locations.

–For the “old” BPM, we take a snapshot at the Pbar Injection Porch, I.e., just before injecting the pbars. The $D_{11/17}$ measurement takes place ~ 20 min. afterwards, however, hopefully, the orbit is stable during the pbar injection.

–For the new “new” BPM, we average for a few seconds the snapshot taken during acceleration. (the acceleration does not starts right away with respect to the snapshot). So, in both case, we do this at 150 GeV, when the machine has been stable for at least ~1 hour.

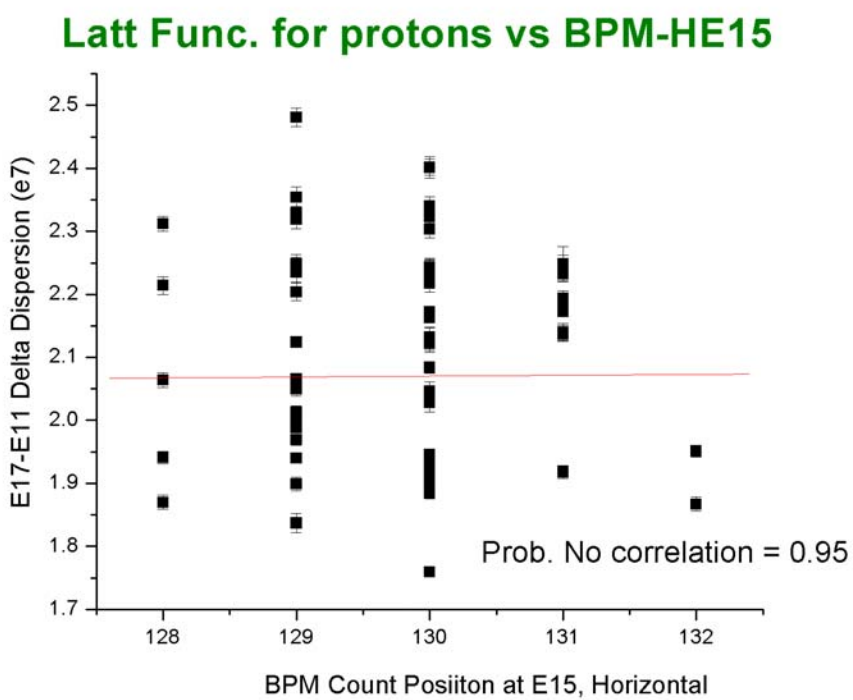
Form some BPM, a statistically significant correlation is indeed observed:

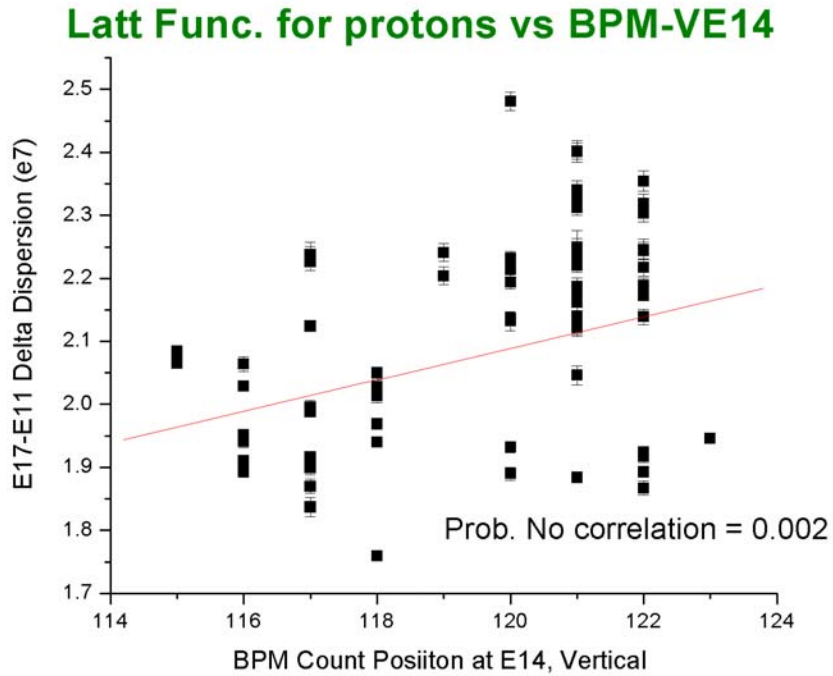




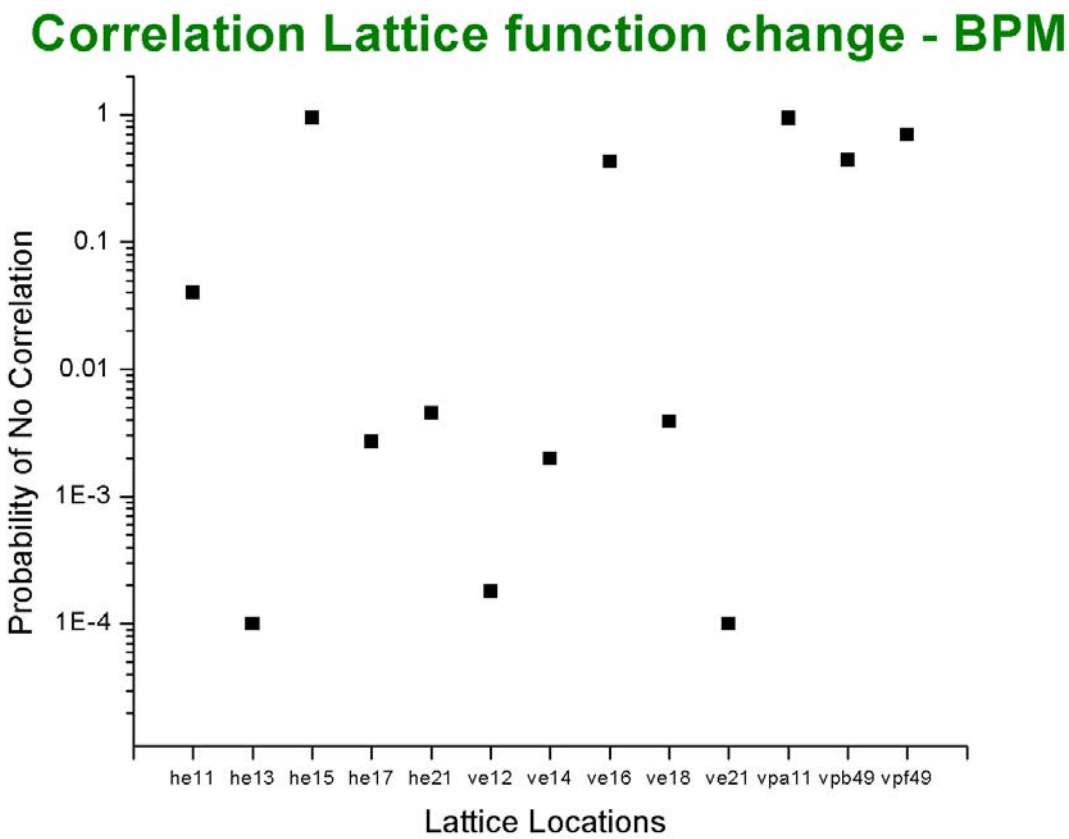
In both cases, the probability that no such correlation is there is less than 0.0001

However, at other locations, no such correlation





Partial Summary…



Outlook.

The fluctuation in the this lattice function could indeed be explained – in part – by orbit variation. The fact that no correlation is observed for some BPM is not all that surprising, because we only see such variation in the horizontal plane to start with.

However, this is a rather "screwy" way to study the lattice, we probably should focus on a more systematic way to determine these higher multi-poles..